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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/076,099	02/15/2002	Wayne L. Johnson	P 273243 PC0033A Reg	8536

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EXAMINER	
MCDONALD, RODNEY GLENN	
ART UNIT	**PAPER NUMBER**
1753	

DATE MAILED: 02/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/076,099	JOHNSON ET AL.	
	Examiner	Art Unit	
	Rodney G. McDonald	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 19-27* is/are rejected.

7)☒ Claim(s) *7-18* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

Claims 21-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 21 is indefinite because "said valve control means" lacks antecedent basis.

Claim 22 is indefinite because "said valve control means" lacks antecedent basis.

Claim 23 is indefinite because "said injection valve" lacks antecedent basis.

Claim 24 is indefinite because "each said injection valve" lacks antecedent basis.

Claim 25 is indefinite because "each said gas injection nozzles" lack antecedent basis.

Claim 26 is indefinite because "said gas injection plate" lacks antecedent basis for comparison.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-4 are rejected under 35 U.S.C. 102(e) as being anticipated by Winniczek et al. (U.S. Pat. 6,093,332).

Winniczek et al. teach providing ***a pulsed RF bias power to a chuck and alternates the RF power between a high power level and a low power level*** at a predefined pulse frequency. By selecting the appropriate ***pulse frequency, duty cycle, and power levels (i.e. three values)*** to allow polymer ***deposition to occur*** on the mask surface while the pulsed RF bias power is in the low power cycle, overall mask erosion may be reduced. During the high power cycle, etching of the underlying layer takes place through openings in the mask. (Column 3 lines 50-59)

In one embodiment, the present invention is practiced in a TCP.TM. 9100 low pressure, high density plasma reactor, which is available from Lam Research Corporation, although, as mentioned above, any other conventional and suitable plasma processing systems may well be employed. FIG. 3 illustrates a simplified schematic of the TCP.TM. 9100 plasma reactor 300, including ***a plasma processing chamber 302***. Above chamber 302, there is disposed an electrode 304, which is implemented by an induction coil in the example of FIG. 3. Coil 304 is energized by a RF generator 305 via a matching network (not shown in FIG. 3). The RF power supplied to coil 304 may have an RF frequency of, for example, 13.56 MHz. (Column 4 lines 15-27)

Within chamber 302, there is provided ***a gas distribution plate 308***, which preferably includes a plurality of holes for distributing gaseous source materials, e.g., the etchant source gases, into the RF-induced plasma region between itself and a substrate 310. The gaseous source materials may also be released from ports built into the walls of the chamber itself. ***Substrate 310 is introduced into chamber 302 and disposed on a chuck 312, which acts as the bottom electrode and is preferably***

biased by a radio frequency generator 314 (also typically via a matching network). (Column 4 lines 28-37) Figure 3 provides a pump means. (See Figure 3)

In accordance with one aspect of the present invention, ***the RF bias power supplied to the bottom electrode, e.g., to chuck 312, is pulsed between a high power level and a low power level at a predefined pulse frequency in order to reduce mask erosion during etching.*** To facilitate discussion of this aspect of the present invention, FIGS. 4 and 5 depict the contrast between a continuous RF bias power wave form, such as that typically employed in the prior art etch, and the pulsed RF bias power wave form employed to reduce mask erosion in accordance with the present invention. (Column 4 lines 47-56)

In FIG. 5, the RF power is also supplied at a predefined RF frequency (although a constant RF frequency is not required by the invention). ***Unlike the continuous RF bias power waveform of prior art FIG. 4, however, the maximum amplitude of the RF bias power waveform of FIG. 5 alternates between a high power level $P_{MAX\text{-}HIGH}$ and a low power level $P_{MAX\text{-}LOW}$.*** Thus, during the low power cycle, the average power ($P_{AV\text{-}LOW}$) delivered to the chuck electrode is lower than the average power delivered to the chuck electrode during the high power cycle ($P_{AV\text{-}HIGH}$). The RF bias power waveform alternates between the low power level and the high power level at a predefined pulsed frequency f_{PULSE}, which is the inverse of the pulse period (506) shown. The duty cycle is defined by the ratio of the duration of the high power cycle (502) relative to the duration of the pulse period (506). (Column 4 lines 64-68; Column 5 lines 1-12) In Figure 5 the RF power is sinusoidal. (Figure 4)

In accordance with one aspect of the present invention, ***the pulse frequency (i.e., the frequency at which the RF power supplied to the chuck electrode alternates between the high power level and the low power level) is selected to be sufficiently low to permit polymer to be deposited on the mask surface during the low power cycle.*** At the start of the high power cycle, this deposited polymer acts as a sacrificial layer to afford some protection to the underlying mask material. ***Accordingly, even if the entire thickness of the deposited polymer is eroded away during the high power cycle, less of the mask material is etched away since the presence of the deposited polymer at the start of the high power cycle reduces the amount of time the mask material is exposed to the etchant material during this high power level.*** (Column 5 lines 13-27)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation

under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Winniczek et al. (U.S. Pat. 6,093,332) in view of Heinecke et al. (U.S. Pat. 4,935,661).

Winniczek et al. is discussed above and all is as applies above. (See Winniczek et al. discussed above)

The differences not yet discussed are the control of the energy level and cyclically varying gas pressure.

Heinecke et al. '661 teach an apparatus for pulsed treatment of a substrate surface which includes means for removing spent gas from a region adjacent the substrate for each pulse. The apparatus may also include means for sweeping an intense plasma region across a substrate surface. Rapid gas exchange is provided by pressure pulsing the gas admission. This facility also provides means for rapidly alternating different gases. (See Abstract)

The arrangement shown in Fig. 4 provides a facility for changing the reactant gas from one gas to another with each plasma pulse (or succession of pulses). (Column 6 lines 18-22) To assist gas exchange a gas pulse facility may be provided by the arrangement of Fig. 4a. The amount of gas stored in the vessel 34 should be that which fills the reactor to the required operating pressure measured by the control 15, ***which pressure may change from pulse to pulse,*** and which is then maintained via the flow

meter 30 during the remainder of the plasma pulse. Vessel 34 thus also acts as a buffer to prevent the mass flow controller trying to follow the pulsings. (Column 6 lines 42-55)

As well as film deposition the technique can also be used for etching. For example, using an electrode separation of 20 mm and argon gas at 140 mtorr ***the bias voltage on the ground electrode was varied in the region 0 to -500 V DC to obtain an enhanced plasma which increased the etch rate of SiO whilst decreasing the resist degradation on a patterned Si wafer.*** (Column 11 lines 23-29)

The motivation for control of the energy level and cyclically varying the gas pressure is that it allows overcoming the disadvantages of the prior art. (Column 1 lines 3-55)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Winniczek et al. by controlling the energy and varying the gas pressure as taught by Heinecke et al. '661 because it allows for overcoming the disadvantages of the prior art.

Claims 19—21, 23, 24, 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over in Winniczek et al. view of Mahawili (U.S. Pat. 4,993,358).

Winniczek et al. is discussed above and all is as applies above. (See Winniczek et al. discussed above)

The differences not yet discussed is the feeding of the gases through a manifold that has a plate with a plurality of nozzles and valves, each for supplying gas, and valve control means for controlling the nozzles intermittently.

Mahawili teach "vertical systems" including a susceptor for holding wafers in a chamber typically formed by an inverted bell jar. The susceptor is typically rotated for achieving greater uniformity in coatings across the surface of the wafers or substrate. (Column 1 lines 60-64)

It is further object of the invention to provide CVD reactor with a housing forming a closed chamber suitable for maintaining a wafer or deposition substrate in a controlled environment of selected pressure, etc. With the substrate supported in the chamber, and maintained at typical CVD temperatures, it is subjected to a deposition environment formed with means for introducing reactant gas into the chamber. (Column 2 lines 38-45)

More preferably, the means for introducing reactant gas into the chamber comprise multiple spaced apart orifices, sets of the orifices being in communication with external manifolds preferably of annular configuration. The arrangement of the external annular manifold permits the use of separate regulators in order to introduce one or more gases including reactant gases, carrier gases and the like as necessary for a particular deposition process being contemplated. The invention also contemplates possible use of a portion of the orifices as additional exhaust vents in order to make the CVD reactor or apparatus even more versatile. (Column 3 lines 6-18)

The CVD reactor comprises an upper or external ***plate 28*** forms ten radially spaced gas manifolds. (Column 4 lines 19-20) The inner plate 30 forms an array of gas inlets, ***preferably sonic orifices generally indicated at 32A-50A.*** (Column 4 lines 22-23) Each of the annular gas manifolds 32-50 is provided with ***an external valve or***

regulator 32C-50C in an inlet conduit 32D-50D. The external regulators are adapted for connection with one or more sources of reactant gases such as those schematically indicated at 56 and 58. Depending upon the specific application, different numbers of individual gas source could be employed. In any event, the two sources 56 and 58 indicate the possibility of combining two or more gases to form the reactant gas environment within the chamber 24. For example, in the deposition of silicon dioxide, the two sources 56 and 58 could provide silane and oxygen. However, as noted above, a wide variety of other gases could be employed as contemplated by the present invention In any event, ***the gas sources 56 and 58 are selectively connected with one or more of the external regulators in order to assure optimum flow conditions for the reactant gas within the chamber 24.*** The sources 56 and 58 could be connected with the external regulators, for example, by conduits or the like (not shown). (Column 4 lines 45-65)

At least one additional exhaust passage 66 is formed in an axially central portion of the chamber 24, preferably by the plates 28 and 30. The exhaust passage 66 is similarly in communication with an external exhaust member 68 having an individual control valve 70. The external exhaust members 62 and 68 may be connected for example with a vacuum pump as schematically indicated at 72, for example by conduit or the like (not shown). ***Additional exhaust passages (not shown) could be provided in the center of the chamber 24, if desired.*** (Column 5 lines 10-19)

The control valves 64 and 70 are adapted for sequential operation, preferably by ***automated means (not shown) in order to selectively open or close the individual exhaust passages 60 and 66 between the chamber 24 and vacuum means 72.*** (Column 5 lines 20-24)

The combination of control valves 64 and 70, either alone or in combination with the automated means referred to above, provides a kinetic means for regulating directionality of local flow vectors for reactant gas within the chamber 24 as described in greater detail below in a method of operation for the reactor 10. (Column 5 lines 25-30)

The motivation for providing for feeding of gases is that it allows for enhancing coating uniformity. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized gas feeding means as taught by Mahawili because it allows for enhancing coating uniformity.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winniczek et al. in view of Mahawili as applied to claims 19-21, 23, 24, 26 and 27 above, and further in view of Bates et al. "Fast gas injection system for plasma physics", Rev. Sci. Instrum., Vol. 55, N0. 6, June 1984.

The difference not yet discussed is the use of a piezoelectric valve to regulate the gas flow.

Bates et al. teach a gas injection system that utilizes ***a piezoelectric valve***. (See Bates et al. Abstract)

The motivation for utilizing a piezoelectric valve for a gas injection system is that it allows faster controlled injection. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a piezoelectric valve to control gas injection as taught by Bates et al. because it allows for faster control of gas.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winniczek et al. in view of Mahawili as applied to claims 19-21, 23, 24, 26 and 27 above, and further in view of Eres et al. (U.S. Pat. 5,164,040).

The difference not yet discussed is the use of supersonic gas injection.

Eres teach injecting into the chamber a gaseous source of material in the form of ***a pulsed supersonic jet*** so as to obtain a high incidence rate. ***The supersonic jet is produced by a pulsed valve*** between a relatively high pressure reservoir, containing the source gaseous molecules, and the deposition chamber. (See Abstract)

By alternately pulsing two nozzles, epitaxial structures can be formed in which successive layers have different compositions. (Column 4 lines 5-10)

The motivation for utilizing supersonic gas flow is that it allows for having a high incidence rate. (See abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a supersonic gas injection nozzle as taught by Eres et al. because it allows for having a high incidence rate.

Allowable Subject Matter

Claims 7-18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 7-18 are indicated as being allowable over the prior art of record because the prior art of record does not teach the claimed subject matter of claim 1 in combination with introducing a first process gas into the reactor chamber during a first time period and introducing a second process gas having a different composition than the first process gas during a second time period which follows the first time period.

Response to Arguments

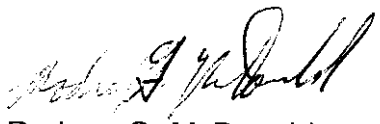
Applicant's arguments with respect to claims 1-27 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's main argument is drawn to the fact that Heincke et al. '690 does not maintain the plasma. The Examiner agrees that Heincke et al. '690 does not maintain the plasma. However, newly cited Winniczek et al. teach maintaining the plasma by utilizing high and low powers during pulsed processing of a substrate which allows a deposition and etch process to occur. It is believed that Winniczek et al. teach introducing at least one gas, creating a plasma by establishing a RF electromagnetic field in the chamber, and varying the RF electromagnetic field such that the substrate is processed differently at different times due to the energy level applied.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 571-272-1340. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
February 10, 2004